REMARKS

Claims 12-20 are pending in the application. By this Amendment, Claims 1-11 are canceled, and new Claims 12-20 are added.

Applicants note that the present application was published by the U.S. Patent and Trademark Office on 13 December 2001 as Publication No. US 2001/0050551 A1. All references to the application are made with respect to this published application.

Claim Rejection - 35 U.S.C. § 112, 1st Paragraph

In the Office Action, the Examiner rejects Claims 1-11 under 35 U.S.C. § 112, 1st paragraph on grounds the application as filed does not enable all of the claimed features. This rejection is respectfully traversed as it might be applied to Claims 12-20.

The Claims are fully supported by the application as originally filed. The originally filed application provides sufficient disclosure to enable a person of ordinary skill in the art at the time of the invention, to make and use the claimed invention.

For example, Claims 1, 10 and 12 are literally supported by numbered paragraph [0012] of the published application. In addition, numbered paragraph [0013] discloses a way to make/use the invention, for example discloses that the phase delay element shall have a phase delay angle that deviates from the typical/ideal phase delay angle. In other words, The phase delay element is a $\lambda/4$ retarder that usually has a phase delay angle of 90°, but in accordance with exemplary embodiments the phase delay element can have a phase delay angle of, e.g., 84° or of 98°, and so forth. In addition, numbered paragraphs [0028] - [0040] explain how the phase delay element has a selectable temperature dependence. Numbered paragraph [0041] gives an example for a successful implementation

of an exemplary embodiment of the invention, including concrete numbers. Numbered paragraph [0042] provides another example including concrete numbers.

If the Examiner's concern is that the meaning of "Verdet-constant" is not clear, Applicants note that it is well-known in the art that the Verdet-constant is the proportionality constant for the Faraday effect. See also equations (1) and (2) in numbered paragraphs [0006] and [0007] respectively, and numbered paragraph [0008]. In addition, numbered paragraphs [0034] - [0046] provide further explanations on how to make/use the invention.

With respect to Claims 5-7 and Claims 16-18, appropriate disclosure is provided in numbered paragraph [0039] and in numbered paragraphs [0013] and [0040]-[0042] of the published application.

With respect to Claims 3 and 14, appropriate disclosure is given in numbered paragraphs [0015] and [0039] of the published application.

Claim Rejection - 35 U.S.C. § 112, 2nd Paragraph

In the Office Action, the Examiner rejects Claims 1-11 under 35 U.S.C. § 112, 2nd paragraph. This rejection is respectfully traversed as it might be applied to Claims 12-20.

In order to aid the Examiner's understanding of the invention and/or to establish a common understanding between Applicants and the Examiner, Applicants will now briefly explain how and why the invention works.

The problem is that changes in temperature influence the measurement results. For example, the sensitivity of the sensor (SK) is temperature-dependent. This is mainly due to

the Verdet constant of the sensor fiber, which has a temperature dependence. Its influence on SK is TV(T) (see Fig.2).

By way of solution, Applicants recognized that the phase delay element also has a temperature dependence, which usually is due to the change of the length of the phase delay element with temperature. This temperature dependence also influences SK. (c) Usually that temperature dependence is very small, when using a "normal" (=ideal) phase delay element. An "ideal" phase delay element has exactly its nominal phase delay angle, typically 90°. But, as can be seen in Fig.3, if there is a deviation δ of the phase delay angle from the ideal angle, the influence of the phase delay element on SK is greater. Therefore, also the influence of the temperature dependence of the phase delay element on the scale factor is greater and can be of the order of magnitude of temperature dependencies of Verdet constants. See for example Figure 2, "TW" and numbered paragraph [0030] of the published application. Accordingly, Applicants recognized that by choosing an appropriate phase delay angle, it is possible to compensate for the influence of the temperature dependence of the Verdet constant. The effective temperature dependence of the sensor is then zero. See curve "K" in Figure 3 of the published application, which is the product of TV and TW, and which is constant, see *e.g.* numbered paragraph [0028] of the published application.

With respect to Claims 1 and 12, Applicants note that the Examiner has asserted that it is unclear, which condition the phase delay element has to meet in order to compensate for the influence ot a Verdet's constant. This assertion is respectfully traversed. Claim 12 clearly recites "*phase delay* of the at least one phase delay element is

chosen such that ...". "Phase delay", as known in the art, refers to the basic property of a phase delay element; it indicates the amount of degrees or radians by which one of the two light waves that can propagate in the phase delay element (and which are polarized perpendicularly to each other) is retarded with respect to the other of the two light waves. Figure 3 of the published application shows how the phase delay of a phase delay element influences the normalized scale factor SK, where the normalized scale factor SK is the sensitivity of the sensor; see also numbered paragraphs [0028] and [0036]-[0038]. The temperature dependence of SK is shown in Fig.2 as TW; see also numbered paragraph [0028].

The Examiner asserted that it is unclear whether the claimed feature of "... phase delay element ... compensates for ... Verdet's constant" is positively claimed. As explained above, this claimed feature clearly indicates which condition the phase delay element has must fulfill in order to achieve the named compensation. Therefore, for at least this reason the claimed feature is positively claimed. Claims 1 and 12 are definite.

If the Examiner continues to believe that Claim 12 is indefinite, then Applicants respectfully request the Examiner to specifically and precisely indicate where he still sees a problem, so that Applicants can precisely and accurately respond.

With respect to Claims 2 and 13, the Examiner has asserted it is unclear what a "phase delay angle whose value deviates from a phase delay angle of an ideal phase delay element" is. Applicants note that this is disclosed and described in numbered paragraph [0029] of the published application. For example, an ideal phase delay element has a phase delay angle that is exactly as large as its nominal phase delay angle. E.g., for a $\lambda/4$

element, the phase delay angle is 90°. If the angle deviates from that, the phase delay angle will amount to $90° + \delta$, where δ is a non-zero angular deviation. For a more general phase delay element, which would be a λ/n element of m-th order, the ideal phase delay angle is $m/n \times 360°$, see numbered paragraph [0029]. As explained above in conjunction with Claims 1 and 12, the deviation (angle δ) allows achievement of the claimed temperature compensation. Therefore, considering what the originally filed application teaches a person of ordinary skill in the art, Claims 2 and 13 are definite.

With respect to Claims 3 and 14, the examiner has asserted that it is unclear what an elliptical core (as recited in Claims 3 and 14) is. As recited in Claim 14, the phase delay element is a "...fiber segment with an elliptical core". It was widely known to persons of ordinary skill in the art at the time of the invention, that a) an optical fiber basically includes a core and a cladding, and b) the cross-section of the core of the segment of optical fiber, which constitutes the phase delay segment, is elliptical if "a fiber segment with an elliptical core" is referred to. See also numbered paragraph [0039] of the published application. In other words, optical fibers with elliptical cores were well known in the art at the time of the invention. Accordingly, Applicants respectfully submit that Claims 3 and 14 are definite.

If the Examiner continues to assert that Claims 3 and 14 are indefinite, then Applicants respectfully request the Examiner specifically and precisely indicate where he still sees a problem, so that Applicants can squarely and carefully resolve it.

With respect to Claims 4 and 15, the Examiner has asserted that it is unclear what "(selected as) a function of a mutual alignment of the fast axes" means. Applicants

respectfully submit that numbered paragraphs [0041] - [0043] of the published application clearly disclose what this means. A phase delay element always has a fast axis and a slow axis. The fast axis is the axis of the fiber that runs along the direction of the polarization of that lightwave which is "ahead" of the other lightwave. That other lightwave is delayed with respect to the faster lightwave (see also the explanation above with respect to Claim 12). When there are two phase delay elements in a fiber optic arrangement, their fast axes are rotated with respect to each other by some angle. *I.e.*, they have some relative alignment to each other, *i.e.*, a mutual alignment.

As can be calculated (using Jones matrices, see for example numbered paragraph [0043] of the published application), the scale factor SK depends on the mutual alignment of the fast (or slow) axes of the two phase delay elements. See also Figure 3 of the published application, in which A, B and C relate to different alignments of the fast axes (numbered paragraph [0037] of the published application). Accordingly, the magnitude of the phase delay of the phase delay element can be selected in dependence on (or as a function of) this mutual alignment in order to achieve the desired temperature compensation. The two numerical examples in numbered paragraphs [0041], [0042] of the published application also show this. Accordingly, Applicants respectfully submit that Claims 4 and 15 are definite.

If the Examiner continues to assert that Claims 4 and 15 are indefinite, then Applicants respectfully request the Examiner specifically and precisely indicate where he still sees a problem, so that Applicants can squarely and carefully resolve it.

With respect to Claims 5-7 and 16-18, the Examiner has asserted that it is unclear what "a function of a sign ... phase delay element..." means. Applicants respectfully submit that numbered paragraphs [0040] -[0042] of the published application clearly describe what these terms mean. The contribution of the phase delay element to the temperature dependence of the sensitivity of the sensor has a sign. That sign is positive if TW increases with increasing temperature, whereas the sign is negative if TW decreases with increasing temperature (see examples in numbered paragraphs [0041], [0042] of the published application). If the temperature dependence TV of the sensitivity of the sensor caused by a temperature dependence of a Verdet's constant of the sensor fiber is positive, then in exemplary embodiments of the invention a negative temperature dependence TW of the phase delay element is selected, and vice versa. Accordingly, the phase delay angle is selected as a function of (or in dependence on) a sign of the contribution of the at least one phase delay element to the temperature dependence of the sensitivity of the sensor. Claims 17 and 18 encompass the two cases of parallel and orthogonal fast axes.

If the Examiner continues to assert that Claims 5-7 and 16-18 are indefinite, then Applicants respectfully request the Examiner specifically and precisely indicate where he still sees a problem, so that Applicants can squarely and carefully resolve it.

Claim Rejections - 35 U.S.C. § 102(b), (e)

In the Office Action, the Examiner rejects Claims 1-2, 5-7 and 9-10 under 35 U.S.C. § 102(b) over WO 98/58268 to Blake, *et al.* (Blake). The Examiner also rejects Claims 1-2 and 6-10 under 35 U.S.C. § 102(e) over U.S. Patent No. 5,953,121 to

Bohnert, *et al.* (Bohnert). These rejections are respectfully traversed as they might be applied to Claims 12-20.

Applicants first note that in the Office Action at the ends of numbered paragraphs 4 and 6, the Examiner states that "It is noted that the limitation of 'the at least one phase delay element has a phase delay with a temperature dependence which at least approximately compensates for a temperature dependence of a Verdet's constant (V) of the sensor fiber' [recited in Claims 1 and 10] *is not given any patentable weight.*" This assertion violates the rule set forth by the Federal Circuit in *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987), where the court stated "A claim is anticipated only if *each and every element* as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." See MPEP § 2131, for example at page 2100-69 of the August 2001 edition of the MPEP.

The Examiner has failed to establish a *prima facie* case of anticipation with respect to each of Blake and Bohnert, because the Examiner has provided no reference or citation that discloses or suggests the feature of "*the at least one phase delay element has a phase delay with a temperature dependence which at least approximately compensates for a temperature dependence of a Verdet's constant (V) of the sensor fiber*", recited in Claims 1 and 10, and similar features recited in Claim 12.

In addition, Applicants note that Blake describes ways to compensate for influences of linear birefringence of the sensing fiber (see „Summary of the Invention" in Blake, pp. 2-3). As mentioned in Blake (see for example Page 2, Line 7; Page 8, Line 24; Page 10, Line 22) changes in temperature may cause changes in birefringence in the sensing fiber.

However, this has nothing to do with the temperature dependence of the Verdet constant of the sensing fiber, or with compensating for this temperature dependence of the Verdet constant. The temperature dependence of the Verdet constant of the sensing fiber is not mentioned or recognized in Blake, and Blake fails to disclose or suggest any mechanism to compensate for this temperature dependence of the Verdet constant. Blake discloses at Page 6, Lines 16-20 that the phase delay element (40) is ideally a quarter of a polarization beat length long. However, Blake completely fails to disclose or suggest any deviation from this length or corresponding phase delay.

For at least the above reasons, Blake fails to disclose or suggest a fiber optic current sensor including a coiled sensor fiber which encloses a current conductor and at least one phase delay element adjoining the sensor fiber, wherein the phase delay of the at least one phase delay element is chosen such that a contribution of the at least one phase delay element to the temperature dependence of the sensitivity of the sensor at least approximately compensates for a contribution of a Verdet's constant of the sensor fiber to the temperature dependence of the sensitivity of the sensor, as recited in Claim 12.

Bohnert describes ways to provide a temperature compensation for a magneto-optic current sensor. The temperature effects Bohnert compensates for are changes of the linear birefringence of the sensing fiber (sensor coil) with temperature. Bohnert's sensing fibers are largely free from mechanical stress and therefore approximately free from linear birefringence (Bohnert, col.4, l.24-26 and col.6, l.6-9). Therefore only negligible changes of linear birefringence of the sensing coil occur upon temperature changes. However, Bohnert fails to recognize or disclose the temperature dependence of the Verdet constant of

the sensing fiber, and likewise fails to disclose or suggest a mechanism for compensating the temperature dependence of the Verdet constant of the sensing fiber. Bohnert discloses at Column 5, Lines 45-51 that the length of the phase delay element ($\lambda/4$ time delay element) may deviate from the ideal value by a *tolerance* angle δ. However, a tolerance is a *randomized* allowed deviation from an optimum value, so as to allow for efficient production or manufacturing of a device that provides acceptable function in spite of imperfections. In other words, a tolerance indicates a maximum acceptable magnitude of random imperfections in a manufactured product. Such a tolerance angle cannot anticipate a phase delay element that "*is **chosen** such that a contribution of the at least one phase delay element to the temperature dependence of the sensivity of the sensor at least approximately compensates for a contribution of a Verdet's constant of the sensor fiber to the temperature dependence of the sensivity of the sensor*", as recited in Claim 12, and which "*has a phase delay angle whose value deviates from a phase delay angle of an ideal phase delay element*" as recited in Claim 13. The optimum value for the length of the phase delay element according to Claim 13 is such that its phase delay angle deliberately and specifically deviates from the phase delay angle of an ideal phase delay element. This deviation is not by random and/or to compensate for productional or other imperfections. Therefore the tolerance angle δ and phase delay element length in Bohnert does not anticipate the angle and/or length of the phase delay element according to the invention under discussion. Accordingly, Bohnert fails to anticipate the claimed invention.

For at least the above reasons, Applicants respectfully submit that Blake and Bohnert, when considered both separately and in combination, do not disclose or suggest all of the features recited in Claims 12-20.

Conclusion

Applicants respectfully submit that the application is in condition for allowance. In the event any questions arise regarding this communication or the application in general, the Examiner is invited to contact Applicants' undersigned representative at the telephone number listed below.

Respectfully submitted,

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Date: 31 March 2003